

Functioning River and Floodplain Systems: Vermont's Management Standard

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In response to annual state and regional flood disaster declarations, the Vermont Rivers Program has guided the adoption of new and protective state rules governing stream alterations (12-23-13) and flood hazard area and river corridor land uses (10-24-14), capping a landmark period in Vermont's commitment to protect and restore the state's natural rivers and floodplains.

Over the past decade, the Vermont Rivers Program and its partners have worked to assess the fluvial geomorphic conditions of Vermont streams. The resulting body of data has fueled new public policy that recognizes how critical it is to integrate river and floodplain management programs in order to achieve the *state's water quality, ecological integrity, and public safety objectives*. The Vermont General Assembly passed a series of bills, from 2010 to 2014, recognizing the vital importance of functioning floodplains and river corridors in managing streams toward a naturally stable, least erosive form (i.e., equilibrium condition). Streams that can meander and access floodplains are part of riparian systems that store water, sediment, nutrients, and woody debris during flood events. Streams that are channelized and encroached upon can become vertically unstable and erode downward (i.e., incising), losing access to their floodplains and becoming more energized and destructive during flooding. Floodplain function has been lost along 75% of Vermont stream miles where channels have become moderately to severely incised. In effect, vertical stability and floodplain function are two sides of the same coin.

The new Rules establish the following set of performance-based standards for stream equilibrium, connectivity, and river corridor protection, all of which promote the fluvial processes that connect rivers and floodplains as one functioning riparian system:

Stream Alterations: To avoid adverse effects to public safety and significant damage to fish, wildlife, and riparian owners, the Vermont Agency of Natural Resources applies the following performance standards in reviewing activities (others than those addressing existing threats to public safety) that alter the course, current, or cross-section of a perennial stream:

Equilibrium Standard - An activity shall not change the physical integrity of the stream in a manner that causes it to depart from, further depart from, or impedes the attainment of the channel width, depth, meander pattern, and slope associated with the stream processes and the equilibrium conditions of a given reach of stream, resulting in no unnatural aggrading (raising) or degrading (lowering) of the channel bed elevation along the longitudinal stream bed profile.

Connectivity Standard- An activity shall not alter local channel hydraulics, natural streambank stability, or floodplain connectivity in a manner such that changes in the erosion or deposition of instream materials results in a) localized, abrupt changes to the horizontal alignment of streambanks or vertical profile of the stream bed, or create a physical obstruction or velocity barrier to the movement of aquatic organisms. A person shall not establish, construct, or maintain a berm in a flood hazard area or river corridor unless authorized temporarily as an emergency protective measure.

River Corridor Encroachment: To avoid adverse impacts to public safety from fluvial erosion hazards, the Vermont Agency of Natural Resources applies the following performance standard in reviewing land uses under state jurisdiction:

River Corridor Standard: Proposed development shall provide for a meander belt and riparian buffer that ensure no increase in fluvial erosion hazards by causing the river reach to depart from or further depart from the channel width, depth, meander pattern, and slope associated with natural stream processes and equilibrium conditions. Proposed development shall not be approved, if, as a result of the development, there is an immediate need or anticipated future need for stream channelization that would increase flood elevations and velocities or alter the sediment regime triggering channel adjustments and erosion in adjacent and downstream locations.

These standards are used to manage instream activities and riparian land uses to achieve the same end: vertically stable streams and naturally functioning floodplains. The Agency is also under statutory mandate to promote the adoption of these protections at the municipal level. These avoidance-based strategies at the state and municipal levels of jurisdiction are now beginning to reverse decades, if not centuries, of river and floodplain alterations. This precedent-setting work recognizes that natural floodplain function depends on sound river management, and geomorphically stable and ecologically functioning rivers depend on the erosion and deposition processes that occur in a river meander belt and riparian buffer system¹ unconstrained by human activity.

The following list of river corridor planning and protective actions, for managing toward functioning river and floodplain systems, would not have been achieved without our local, state, and federal agency and NGO partners (follow underlined hyper-links for more information):

- ~17,820 miles of River Corridors: web-published as designated small stream setbacks² (D.A.<2 sq. miles)
- ~11,000 bridges and culverts assessed for geomorphic compatibility and aquatic connectivity
- ~5,780 miles of River Corridor: web-published, GIS-delineated meander belts with buffers²
- ~2,000 miles of River Corridor: meander belts delineated using field survey data³
- >100 [River corridor plans](#) based on [fluvial geomorphic assessments](#)
- 52 [River corridor easements](#) (1000 acres) purchasing channel management rights on 24 river miles
- 35 Vermont municipalities (out of 250) have adopted river corridor maps and zoning bylaws
- 11 Vermont Regional Planning Commissions (out of 11) partnering to support municipal adoptions

Completed from 2013-2015

- Flood Ready [web page](#) with individual Community Risk Assessments and copious river corridor outreach
- Publication of a [Statewide River Corridor Base Map](#) (11-25-14)
- State adoption of [Flood Hazard Area and River Corridor Protection Procedures](#) (12-05-14)
- Adoption of fluvial geomorphic-based [Standard River Management Principles and Practices](#) (6-12-15)
- Implementation of a [River-Roads](#) training program for state and municipal road technicians
- Municipal guidance on authorizing and conducting post flood, instream [emergency protective measures](#)
- The [Vermont Economic Resiliency Initiative](#) by the Agency of Commerce and Community Development⁴
- FEMA hazard mitigation grant (9-14-15) to combine transportation corridor and river corridor planning

¹ The Vermont River Corridor is defined as the land area adjacent to a river that is required to accommodate the dimensions, slope, planform (i.e., meander belt), and riparian buffer of the naturally stable channel and that is necessary for the natural maintenance or natural restoration of a dynamic equilibrium condition and for minimization of fluvial erosion hazards, as delineated by the Agency in accordance with the ANR River Corridor Protection Procedures (10 V.S.A. §1422(12)).

² Delineated corridors and designated small stream setbacks, web-published as a Statewide River Corridor Map Layer, are protected in the state's regulation of activities that are exempt from municipal jurisdictions (state buildings, state infrastructure, utilities, farm and forest structures) or fall under state land use jurisdiction (Act 250, i.e., large subdivisions and commercial/industrial development). The Vermont River Corridor Map is made to augment the NFIP flood inundation maps from a floodplain protection standpoint. Most Vermont rivers were incised when NFIP maps were made, which greatly compromised their utility in identifying those land features required to attenuate flooding. Vermont's management standards help ensure that natural floodplains may be reformed by the river within a protected corridor, mitigating both flood and fluvial erosion hazards.

³ Rivers Program has received a FEMA HMP Grant to integrate all field-assessed river corridors into web-published statewide river corridor layer.

⁴ State Commerce and Community Development and Natural Resource agencies teamed up to map a statewide river corridor layer; examine the vulnerability of economic assets in every Vermont community; and assemble a toolbox of both avoidance and mitigation actions, in part, focused on engaging the Vermont business and development community in protecting river corridors and floodplains.